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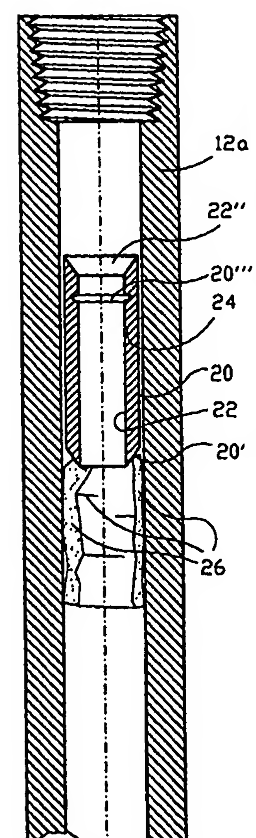
(54) Title: A METHOD AND AN ARRANGEMENT FOR DETECTING AND LOCALIZING FOUL MATTER INTERNALLY IN A PIPE STRING

(57) Abstract

In a method and an arrangement for detecting and localizing e.g. cement deposits internally in drill strings, a sleeve-shaped indicator body (20) is used, the body being dropped down through the drill string while the same occupies an operative position. Then, the indicator body (20) lands either in a seat at the lower end of the drill string, whereby the overlying drill string may be considered free of deposits, or the indicator body (20) becomes stuck within a pipe section (12a) at a higher level in the drill string. Upon the subsequent disassembly of the drill string, one localizes the indicator body (20), the examination taking place in a certain succession where the pipe section which took the lowermost position in the drill string is examined first; thereupon the pipe section which took the lowermost but one position and so forth. When the indicator body (20) has been localized, one can rest assured that the pipe sections which took position above the localized indicator body (20) have no deposits.



A METHOD AND AN ARRANGEMENT FOR DETECTING AND LOCALIZING FOUL MATTER INTERNALLY IN A PIPE STRING

The present invention relates to a method for detecting and localizing foul matter, deposited cement, contaminants, etc. internally a pipe string or tubing, preferably a drilling string of significant longitudinal extent, consisting of drilling pipes, preferably drill collars and a bit at the free outer end thereof, said method being based on dropping a weight body narrower than the bore diameter, down through the pipe string.

Likewise, the invention relates to a device comprising auxiliary means for use upon detecting and localizing cement deposits and other contaminant deposits within pipe strings and tubings having significant length extent and composed of built up pipe sections/pipe lengths/individual pipes.

It is very important to have such deposits and lumps localized and removed, which to a larger or smaller degree clog or throttle the drilling string bore. These bore diameter reducing coating build-ups and deposits result often from previous pumping of cement through the drilling string.

Lumps of contaminating substances from circulated cement slurry could represent a clogging phase if they land in the nozzles of the bit which, thus, become clogged or become so throttled that the circulation within the drilling string is influenced in a negative sense. Therefore, it is usual to "trip" (run in and pull out) the drilling string, test the individual pipe sections in storage position in the derrick, and clean the pipe section(s) containing deposits and/or lumps, prior to a new run of the drilling string in the well can be carried out.

A drilling string consists of pipe sections screwed together, each section normally consisting of three pipes or pipe lengths interconnected through screwing. After each time's use of a drill string, the screw connections between the individual pipe sections (a length of about 30 metres) are unscrewed. The pipe sections are usually not demounted into single pipes, but are stored on board the drilling platform in their full lengths, uppermost engaging supportingly into a finger board up in the derrick, resting with their lower ends on the drill floor. Within the derrick, at the level of the finger board, a person sits in order to drop a ball or another heavy weight body down through each pipe section.

If said weight body falls through the respective pipe section without being stopped, the pipe section is considered to be internally non-clogged and could be used for drilling again at a later point of time without further treatment.

If the weight body, on the other hand, is stopped within a pipe section, this is a sign of the occurence of internal deposits, and the pipe section has to be cleaned, possibly after having been dismounted into the three pipe lengths thereof. Working in the derrick is associated with elements of risk, and this prior art detecting method is bothersome, troublesome and time-demanding. Each individual pipe section

has to be tested no matter what place it took in the drill string.

The method and the device according to the invention allow in most cases, where no deposits occur, that one with certainty can assume that the entire drill string is sufficiently clean without having to control each and every pipe section.

The method according to the invention distinguishes itself through the use of a sleeve-shaped/tubular indicator body with a smaller lateral measure than the diameter of the drill string bore and which, in situ, from a surface position is dropped down through the drill string, landing at a place further down within the drill string, said place, at a later stage, subsequently to disassembling the drill string, can be determined by testing the individual pipe sections, e.g. through a measure indication from one end of the pipe section to the other, in connection with the tripping in/storage of the individual pipe sections on the drill floor.

The sleeve-shaped/tubular indicator body can be adapted to emit radioactivity, or it may be provided with an active radio chip adapted to be detected by means of a magnetic field established outside that pipe section which at any time is being examined in order to recover the indicator body and determine the place positioned at the highest level, referred to the drill string's position of use, where deposits occur. Then, at this highest positioned place within the drill string, the deposits have stopped the further movement of the indicator body downwardly within the drill string, and above the determined highest positioned place there are no internal deposits, coatings or other accumulations of cement or mud constituents, formation sand, etc. As soon as one has positionally determined and recovered the indicator body and, thus, localized the pipe section exhibiting deposits, the remaining pipe sections which, thus, were positioned above that place within the drill string where the indicator body

was stuck, can be considered as deposit-free internally. These pipe sections do not need any testing and may immediately be stored for subsequent use in the next run of the drill string. On the other hand, pipe sections which occupied positions within the drill string below said recorded deposit's "highest place", may contain coatings. Therefore, the indicator body is dropped once more down into the remaining part of the drill string.

At one end thereof, the end being the lowermost in the position of use, the indicator body may be formed with an external, conical, downwardly tapering stop portion. A special pipe piece having an externally threaded socket at one end thereof and an internally threaded pin at the other end, is, thus, formed for interconnection with an overlying drill pipe of the drill string and an underlying drill collar of the same. The special pipe piece has a stepped bore comprising two coaxial bore portions passing into each other through a short transition portion connecting the upper bore portion, the diameter thereof agreeing with the bore diameter of the overlying drill pipe, the latter diameter exceeding the diameter of an underlying bore portion which agrees with the diameter of the underlying drill collar. In the transition between the two longitudinal bore portions having different diameters, this special pipe piece has an internal, conical, downwardly tapering seat which is substantially complementary to the external, conical stop portion of the indicator body at the lower end thereof.

The indicator body may, in situations where no deposits exist in the upper pipe sections of a drill string, be adapted to point this out immediately after hauling the special pipe piece up in connection with the drill string's pulling up (tricing), namely upon inspection of the special pip piece as the first detecting/ localization operation, in order to ascertain whether the indicator body has landed in the seat or not.

In order to remove the indicator body in case it has stopped in an area of deposits, a tool may be used, said tool being lowered down into the pipe section. This hoisting tool may have the form of a U-shaped hoop having a somewhat resilient U-hoop legs in the plane of the legs and an upper, heavy web loading the tool with a weight. The tool is hoisted down into the pipe concerned, suspended from a line attached to said web at the central point thereof. Laterally, the free outer ends of the U-hoop legs are directed away from each other. Internally, the indicator body has a circumferential groove in communication with the bore.

Uppermost, the indicator body may be formed with a conical, tapering insertion aperture for guiding said U-hoop-shaped tool and temporary clamping of the two, possibly three oppositely directed free outer ends which, thereafter, resile out into engagement position in the area of said internal circumferential groove, so that the upper faces on said outwardly directed, free outer ends of the U-legs engage in below the downwardly facing face defining the internal circumferential groove from above, whereupon the indicator body can be hoisted up and used once more.

For localizing the pipe section of the disassembled drill string within which the indicator body is positioned immediately, the indicator body may have one of two advantageous embodiments.

In one embodiment, the indicator body is provided with a cord having a small plummet at the outer, free end thereof. The cord has such a length that a portion of it will project out from a pipe section's end if the indicator body itself has got stuck within a pipe section, irrespective of where in the pipe section the wedging of the indicator body did arise. The cord may e.g. have a length between indicator body and plummet of almost 30 meters.

In a second embodiment, a tubular indicator body according to the invention has a length substantially corresponding to the length of the pipe section, i.e. about 30 meters, a wedging of this long indicator body anywhere in the pipe section concerned will cause an end portion of the tubular indicator body to project out from the upper end. This situation can be recorded as soon as the respective pipe section is in the process of being pulled up. Overlying pipe sections of the pipe string can be considered as deposit-free without any need for internal cleaning.

A non-restricting exemplary embodiment of the uses and designs of the invention appears from the attached drawings, wherein:

Figure 1 shows an axial section through a lower portion of a drill string vertically orientated in the figure, and where a special pipe piece according to the invention is mounted in through interconnection by screwing with partly an overlying drill pipe section, partly an underlying drill collar;

Figure 2 corresponds completely to figure 1 in respect of the drill string portion, but here a sleeve-shaped/ tubular indicator body, which has been dropped down through the drill string from a surface position, has landed in the special pipe piece's seat with its complementarily shaped lower end;

Figure 3 is a partial view showing an axial section through a pipe section and a therein stuck indicator body;

Figure 4 corresponds to figure 3, but here a hauling tool has been lowered down from a surface position, said tool being connected to the end of a cord and serving to be brought into a firm engagement with an indicator body stuck within a pipe section, in order to haul it up by means of the cord;

Figure 5 shows the indicator body separately in axial section;

Figure 6 shows the pulling-up tool separately in side elevation view;

Figure 7 shows a special embodiment in which, in the position of use, the indicator body, at the lower end thereof, is provided with a downwardly suspended cord having a plummet at its lower end;

Figure 8 shows a very long indicator pipe having a length corresponding to each of the pipe sections (30 meters) included in the drill string, and in which this tubular indicator body/indicator pipe has been stuck at the lower end of a pipe section.

First, reference is made to figures 1 and 2, showing a short partial view of a drill string, and in which a special pipe piece 10 has been mounted in between and, at the ends thereof, screwed firmly to an overlying drill pipe/pipe section 12 and an underlying drill collar 14, respectively.

The special pipe piece 10 has an upper, central bore portion 16 having a diameter corresponding to the overlying pipe section's 12 bore diameter, and a lower bore portion 16' extending coaxially with the upper bore portion 16 and having a smaller diameter, corresponding to the diameter of the underlying drill collar 14.

Between the bore portions 16 and 16' of the special pipe piece 10, a short transition bore portion 18 has been formed, forming an internal, conical, downwardly tapering seat.

A sleeve-shaped indicator body 20 having a through-going bore 22, said body being shown separately in figure 5, has a

lower, pointed end portion 20' which is substantially complementary to the seat 18 of the special pipe piece 10. The indicator body 20 exhibits an internal, conical, downwardly tapering guide face 20'' at the upper end thereof and is, below the same, formed with an internal circumferential groove 20''' communicating with the bore 22.

The sleeve-shaped indicator body 20 has an outer diameter somewhat smaller than the bore diameter of the pipe section 12 and exceeding the bore diameter of the drill collar 14. The lower conical end portion 20' is, as mentioned, complementary to the seat 18 in the special pipe piece 10, and these will get in engagement, figure 2, in cases where the indicator body 20 which has been dropped from a surface position, falls without hindrances through all overlying pipe sections, of which the pipe section 12 is the lowermost. Below the drill collar 14, only drill collars exist down to the bit.

If one, when carrying out a method for detecting and localizing internal deposits, ascertains that the indicator body 20 has landed in the seat 18, this indicates unambiguously that all overlying pipe sections of the drill string are free of cement deposits, etc. Thus, these pipe sections 12 do not need to undergo further inspection when the drill string has been pulled up and disassembled for storage of the individual pipe sections on the drill floor and in finger board in the derrick.

The drill collars 14 below the special pipe piece 10 of the drill string should in any case be examined in order to detect and localize cement deposits, etc. and, possibly, cleaned prior to the next time's run of the drill string. Such examination can be carried out in the same manner by using an indicator body 20 having a smaller diameter.

When the indicator body 20 has landed in the internal seat 18 in the special pipe piece 10, it is easy to get the indicator body 20 brought out of the pipe piece 10.

If the indicator body 20 has got wedged or in some other way has been stuck in internal deposits 26 in a pipe section 12, see figure 3, the indicator body 20 may have been stuck in the middle portion of a pipe section, from where the distance is about 15 meters to each end.

In accordance with the present invention it is, therefore, designed a simple withdrawal tool 28 to enable withdrawal of the indicator body 20 when the pipe section 12a concerned has been placed on the drill floor in connection with the disassembling of the drill string.

The withdrawal tool 28 is suspended from a hoisting cord 30 and is formed as a U-shaped hoop, the legs thereof being resilient toward and away from each other. The web is relatively thick and heavy, forming fastener at a through-going lateral hole for said hoisting cord 30. The outer, free ends 28' of the U-hoop legs are bent about 90°, pointing away from each other.

When the withdrawal tool 28 is lowered down into the indicator body 20, the outer, free ends 28' come into guided, inwardly displacing contact with the upper, funnel-shaped aperture 20'', such as the free outer ends 28' of the resilient U-hoop legs are kept in this inwardly pressed position of readiness until they a short time afterwards are positioned at the same level as the internal circumferential groove 20''', into which the free outer ends resile and establish a firm and secure engagement. Thereupon, it only remains to pull the cord 30 upward, whereby the withdrawal tool 28 and the indicator body 20 accompany the same and

eventually are removed from the pipe section which, thus, is cleaned and freed from the deposits 26.

Thereupon, the indicator body 20 is once more dropped into the remaining part of the drill string, and the operation is repeated until the indicator body has landed in the special pipe piece 10.

In figures 7 and 8, two advantageous embodiments are shown.

In the embodiment of figure 7, where a sleeve-shaped indicator body 20 has been stuck in underlying deposits 26 within a pipe section 12, the lower end of the indicator body 20 is provided with an indicator cord 32 having a small plummet 34 at the end thereof. The cord 32 has a longitudinal extent exceeding a pipe section's length, 30 meters, to allow the plummet 34, by means of the cord 32, to project out from the closest underlying pipe section end in case the indicator body 20 has become stuck in deposits. In most cases, the pipe section bore is not so fouled with deposits that it is entirely clogged, prohibiting the passage of the cord 32 and the plummet 34 in a downward direction. The pipe section in which the indicator body 20 might have got stuck, will, during tripping, immediately be detected based on the fact that the cord 32 with the plummet 34 is visible below the lower portion of the drill pipe 12.

In figure 8 is shown a particular embodiment for a tubular indicator 20A having a length corresponding to the length of a pipe section, i.e. about 30 meters. Irrespective of where in the pipe section 12 this tubular indicator body 20A has got stuck, an end portion thereof will project outside an end of the pipe section 12 and, immediately, detect and localize the lowermost pipe section of the drill string exhibiting deposits 26 to be removed. As a consequence of the indicator body's 20A considerable weight, any deposits would normally be cleaned away during the displacement of the indicator body

20A through the drill pipes 12. If the indicator body 20 is treated with a radioactive substance or in some other way enabled to emit radioactivity, possibly provided with an active radio chip, the indicator body 20 could be detected during the tripping by means of an external detector located on the drill floor. Preferably, the indicator body 20 should be provided with a bore 22, so that drill fluid can be circulated within the well also after the indicator body has been dropped down.

Claims

1. A method for detecting and localizing foul matter along the bore-defining walls within pipe sections (12) and, possibly, drill collars (14), both, in position of use, included in a pipe string, preferably a drill string, characterized in that a sleeve-shaped/tubular indicator body (20; 20A) having an insignificantly smaller diameter than the bore diameter of the drill string, is dropped through the drill string from surface position, and that the indicator body (20; 20a) lands adjacent the lower end of the drill string if the indicator body (20; 20A) has not been stopped and retained by internal foul matter (26) at a higher level within one of the pipe sections (12) of the drill string, and that the indicator body (20; 20A) is detected subsequently to the disassembly of the drill string into the individual pipe sections (12) thereof, prior to its subsequent mounting and new run, the individual pipe sections (12) and, possibly, other pipes (10, 14) included in the drill string are examined in order to detect and localize the indicator body (20; 20A) by detecting the pipe section, etc., which, through internal deposits, exhibits a constricted bore portion where the indicator body (20; 20A) has got stuck.

2. An arrangement for detecting and localizing foul matter internally in pipe strings, preferably drill strings, characterized by a sleeve-shaped/tubular indicator body (20; 20A) having a through-going bore (22) and a lower, free, preferably conically tapering end formed for cooperating stoppingly with a complementarily formed seat (18) internal in a pipe (10) mounted into the drill string at the lower end thereof.

3. An arrangement as set forth in claim 2, characterized in that said downwardly conically tapering seat (18) has an upper diameter

corresponding to an overlying drill pipe's/pipe section's (12) bore diameter and a lower diameter corresponding to an underlying drill collar's (14) bore diameter.

4. An arrangement as set forth in claim 3, c h a r a c t e r i z e d i n that the sleeve-shaped/tubular indicator body (20) has an upper, internal, downwardly conically tapering inlet portion (20'') having an upper diameter substantially corresponding to an overlying drill pipe's/pipe section's (12) bore diameter, and having a lower transition portion the diameter thereof substantially corresponding to an underlying collar's (14) bore diameter, and that the indicator body (20, adjacent the inlet portion (20''), has an internal circumferential groove (20''') to enable its withdrawal from a pipe section (12) where it might have been stuck.

5. An arrangement as set forth in one or more of the claims 2 - 4, c h a r a c t e r i z e d i n that said pipe (10) for the seat (18) of the indicator body (20) is formed with threaded end portions for interconnection by screwing with coaxial, threaded end portions of drill pipes/collars, and that the internal, downwardly conically tapering seat (18) forms transition portion between an upper bore portion (16), the diameter thereof corresponding to the overlying pipe's (12) diameter, and an underlying, narrower bore portion (16'), the diameter thereof corresponding to an underlying pipe's (14) bore diameter.

6. An arrangement as set forth in any one of the preceding claims 2 - 5, c h a r a c t e r i z e d i n that the indicator body (20) is treated with radioactive substance or in another way enabled to emit radioactivity or provided with an active radio chip, respectively, and that, outside the pipe sections (12) from a disassembled drill string individually, a magnetic field is established in order to detect and localize the indicator body (20).

7. An arrangement as set forth in any one of the preceding claims, characterized in that the indicator body (20) is provided with a cord (32).

8. An arrangement as set forth in claim 2, characterized in that the indicator body (20A) has the form of a very elongated pipe, which may have a length substantially corresponding to the length of a pipe section (12), so that an end portion of this tubular, elongated indicator body (20A) always will project out from the end of a pipe section upon the disassembly of the drill string in case the indicator pipe (20A) has been stopped by foul matter (26).

9. A tool for the withdrawal of an indicator body (20) which has got stuck within a pipe section (12) or landed in its internal seat (18) in a pipe (10), respectively, of which pipe section (12) as well as said pipe (10) with its internal eat (18) are included in a pipe string, especially a drill string, and intended for use in connection with an arrangement as set forth in claim 4, characterized in that the tool (28) which is suspended from a cord (30) having a length approximately corresponding to the longest pipe section/pipe incorporated within the drill string, is formed as an inverted U-shaped hoop where the lower, outer, free ends (28') of yielding hoop legs resiliently returning to the starting position, are angled and oppositely directed, so that the hoop legs are guided yieldingly toward each other during the passage through the funnel-shaped inlet (20'') of the indicator body (20), whereupon they resile back when the angled, free outer ends (28') reach the level of the internal circumferential groove (20''') of the indicator body (20), into which they snap and establish a secure engagement with the indicator body (20).

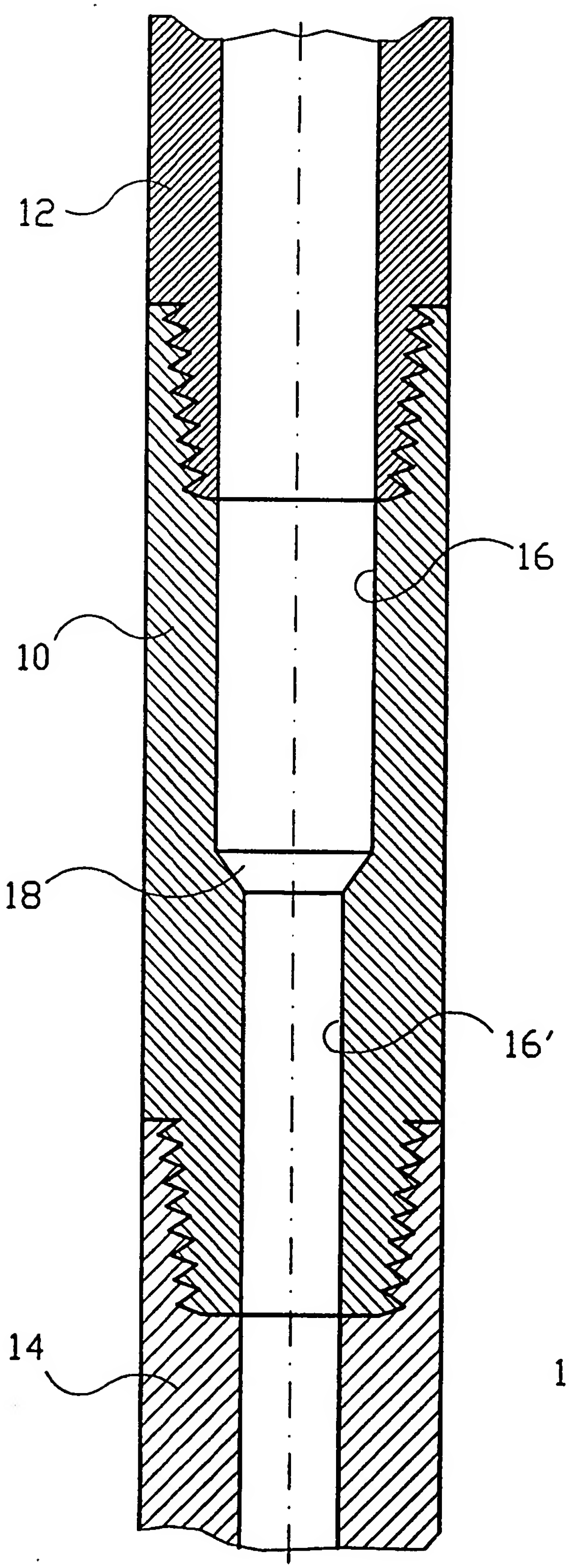


Fig.1

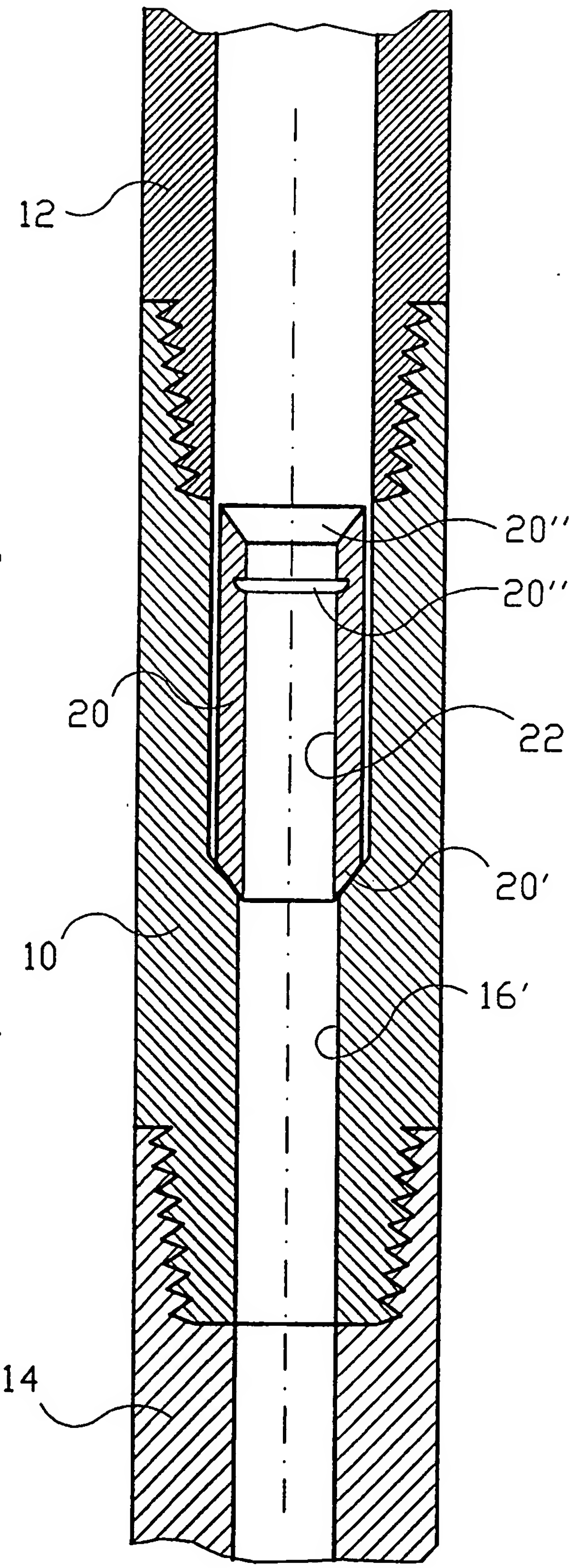


Fig.2

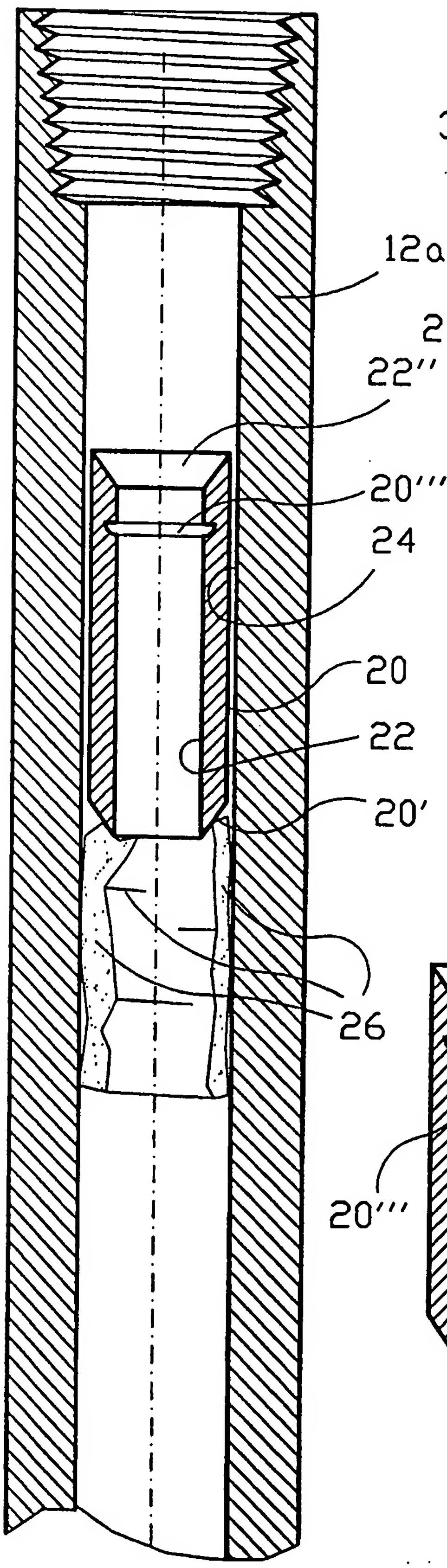


Fig.3

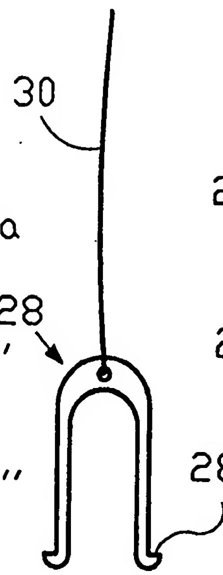


Fig.6

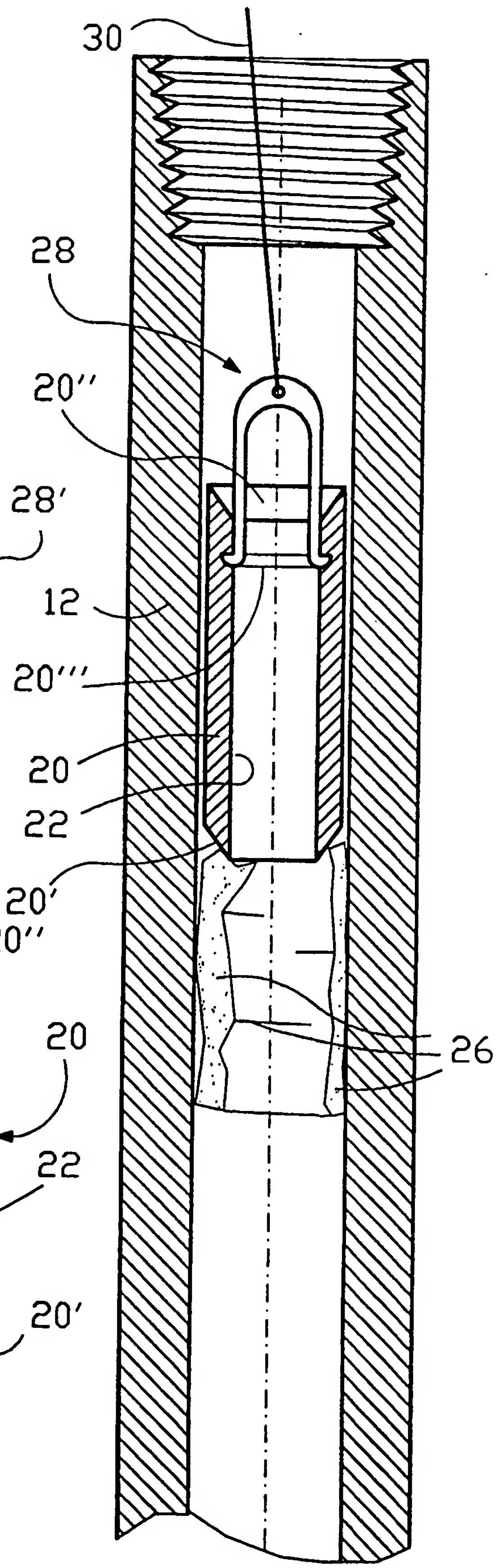


Fig.4

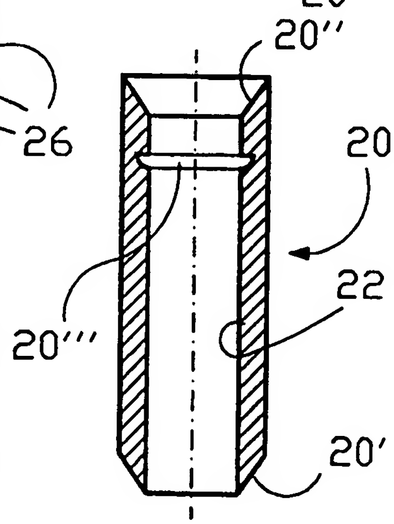


Fig.5

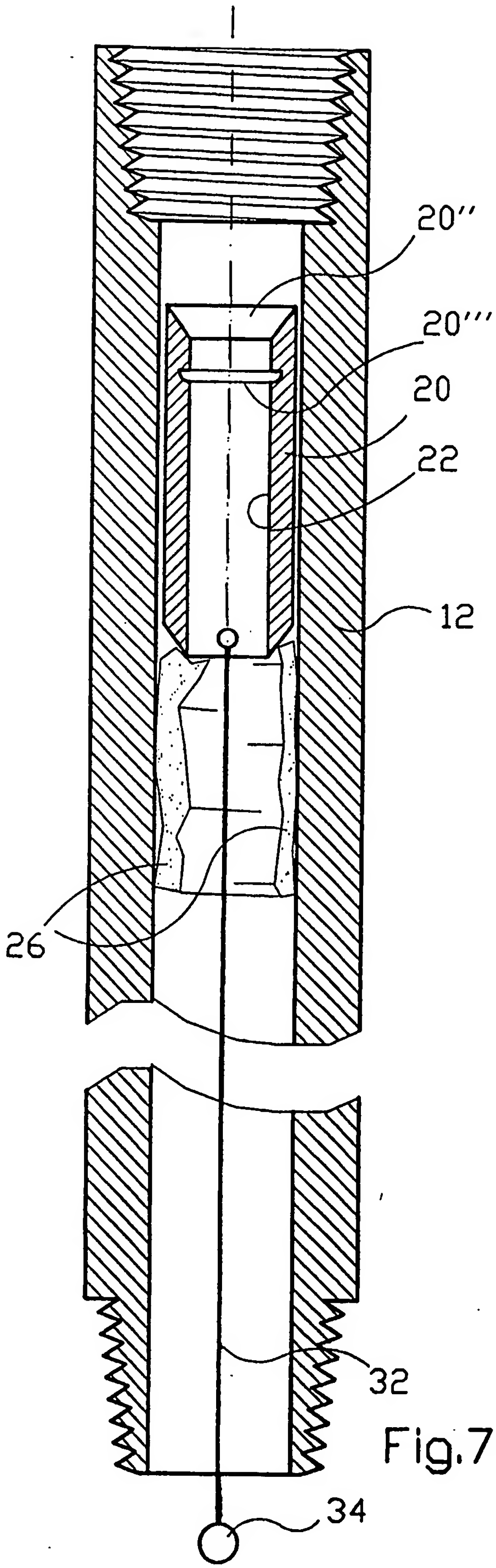


Fig.7

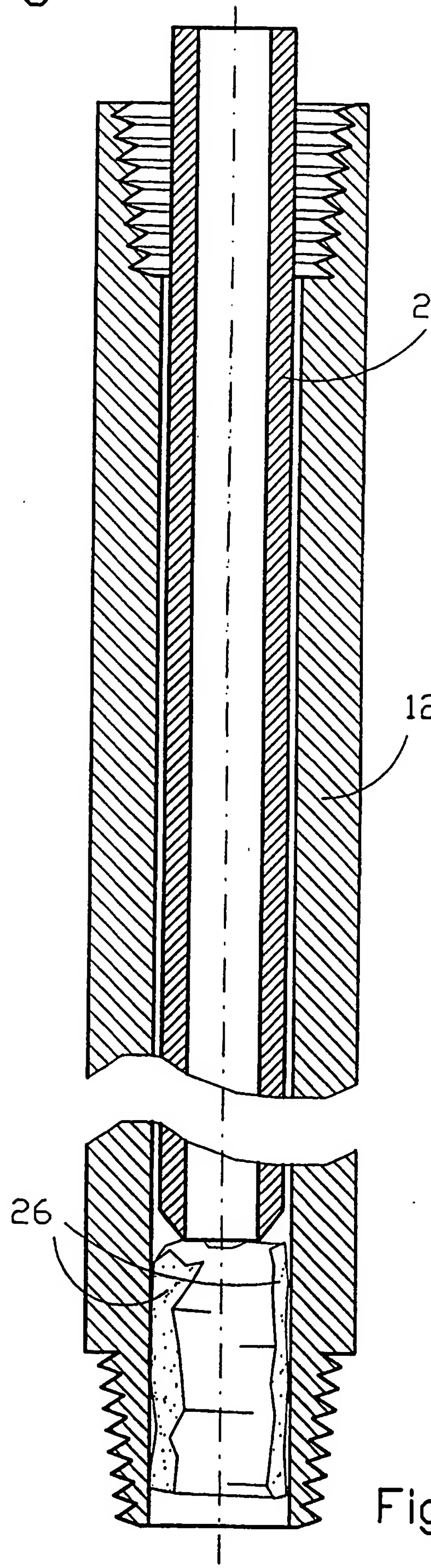


Fig.8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 99/00009

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: E21B 12/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: E21B, G08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4452306 A (J.L. POLLEY), 5 June 1984 (05.06.84), figures 1-9	1,2,7
A		3-6,8,9
	--	
A	US 4169483 A (T.S. BONN), 2 October 1979 (02.10.79)	1-9
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A	US 4242771 A (K.M. KNAPP), 6 January 1981 (06.01.81)	1-9
	--	
A	US 4498932 A (V.R. KRUKA), 12 February 1985 (12.02.85)	1-9
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search	Date of mailing of the international search report
16 April 1999	21 -04- 1999

Name and mailing address of the ISA	Authorized officer
Swedish Patent Office Box 5055, S-102 42 STOCKHOLM	Åke Olofsson

INTERNATIONAL SEARCH REPORT
Information on patent family members

02/03/99

International application No.
PCT/NO 99/00009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4452306 A	05/06/84	CA 1204634 A	20/05/86
		GB 2127563 A,B	11/04/84
US 4169483 A	02/10/79	NONE	
US 4242771 A	06/01/81	NONE	
US 4498932 A	12/02/85	NONE	